# A Curricular and Instructional Challenge: Teaching and Learning for Technological Literacy/Capability

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The role of technology education in the development of technological literacy and capability maintains a constant presence in, and at certain times and places, a point of debate within the field. This debate permeates all levels of the profession—from teachers selecting laboratory/classroom curricula and instructional strategies to institutions of higher education determining how to prepare technicians, technologists, and educators for K-12 and university programs to researchers seeking to establish sound theory and practice for the field. In these situations, as well as many others, views and perceptions are advanced to make a case for a particular focus on what constitutes literacy and capability. Usually this advocacy centers on meeting the needs of the immediate mission—teaching students at the K-12 level; or preparing teachers, technicians, or technologists; or developing the skills and abilities of postgraduate students to serve the diverse demands of research and continued development of the field. How is it then that an agreement can be reached about the similarities and differences between literate and capable when confronted with the scope of teaching and learning about technology across the places and times that students are engaged with technological studies?

The approach to consensus and agreement requires an understanding of the nature of technological literacy and capability, the establishment of a framework that will be inclusive of the many views and perceptions that are held within the many segments and focus areas of the field, and an application of the framework to meet the challenges of developing literacy and capability.

In understanding the continuing theme of developing technological literacy one only needs to go to the continuing discussion and development of the concept within the field of technology education. The fundamental point, that a person must know about technology and be able to do things technologically, is a continuing theme throughout the literature. This literature (Custer & Weins, 1996; Dyrenfurth, 1991; Todd, 1991; Weins, 1988) notes that there are diverse definitions of technological literacy and that these definitions frequently reflect the field or discipline of the definer. However, one key element can be found in this diversity: It is the concept that a person must know about technology and be able to do things technologically.

The literature makes a series of key statements related to the relationships that exist between literacy and capability by:

- Linking literacy and capability. Capability is application, the use of technological knowledge (literacy) to solve practical problems through doing within the full curricular scope of the teaching and learning environment.
- Including curriculum integration by bringing together mathematics, English language arts, science, and social studies with the study and application of technology.
- Providing meaningful, personal realism where the impacts and consequences of technology can be confronted.
- Placing the learner in an active role at the center of achieving literacy and capability for whatever the purpose or mission at hand is.
- Placing achieving literacy and capability on a scale that delineates the increasing complexities demanded by the roles a person takes on in knowing about and using technology—scientist, technology teacher, technician, etc.

Compounding the literacy/capability issue is the specter of technological illiteracy. What are the consequences of not being literate and/or capable?

Here again the literature (Custer & Weins, 1996; Devore, 1991; Dyrenfurth & Kozak, 1991) within the field addresses the consequences of not developing technological literacy. Reasons included are democratic needs, the nature of life in society, dehumanization-humanization, and the nature of jobs-competitiveness-workforce literacy and where the impacts will be if literacy is not achieved. This illiteracy is described as impacting the quality of life and the natural environment in four ways: (a) the inability of citizens to function and contribute in society, (b) the loss of competitive economic potential in business and industry, (c) reduced national security, and (d) economic and political disfranchisement of citizens. All of these points relate to the need for and the significance of technological literacy within society.

## The Challenges

A major assumption of this article is that the field of technological studies is committed to the development of technological literacy and capability as described in the literature. And, that the need for technological literacy and capability is essential to avoid a breakdown in the quality of contemporary life. A major problem exists in how this is to be accomplished. The problem's solution requires answers to the questions of: To what extent or degree should it be achieved at any given time and place? Where should it be achieved? and Who is responsible in achieving literacy and capability?

Streichler (2000) encapsulated the issues that revolve around the above questions by asking the field to establish a framework and formalize a continuum that addresses *technology* and the *learner*. The challenges that must be met in achieving the "continuum" include: changes in professional behavior; bringing segments of the field together; giving up past concepts and processes; and the quality, direction, and quantity of research in the field. The last challenge was further emphasized by the Technology Education Research Conference (Project 2061/American Association for the Advancement of Science [AAAS], 2000), the purpose of which was to think about a common strategy that would best support literacy goals, where it was pointed out that there is fragmentation in approaching the field's research agenda that is driven by discrete contributions without really impacting the educational system as a whole.

It is also important to note that the contributors to Technology Education for the 21st Century (Martin, 2000) touched on the theme of literacy, capability, and achieving a teaching and learning environment centered on the learner and learning. The essayists in this work, each in their own way, all touched on placing the learner at the heart of developing technological literacy and capability by describing exemplary practices that achieve it and in outlining an agenda for taking further action. This desire to center on the learner is not new as is evidenced in the theme of the 1965 American Industrial Arts Association's (AIAA) national convention—"Developing Human Potential Through Industrial Arts" (AIAA, 1965).

With the existence of a segmented, multifocused agenda, the field will continue to define the notion of literate-illiterate to meet the diverse definitions and requirements of the specific contexts of each segment. A way to overcome the problems of segmentation and multiple focuses is to include all the viewpoints in one flexible, operable framework. The elements for this type of inclusive model are available within the discourse, research, and literature of the field. Agreement could be achieved on the basis of these elements and allow each of the segments or focuses in the field to deal with reaching the level of literacy and capability it believes is necessary to meet the needs of its constituency and society in general. This calls for a comprehensive, flexible perspective that gives everyone involved a common foundation, framework, and reference point. If the field cannot define and present this perspective on what technological literacy-illiteracy is, then it faces the danger of being unable to convince society of the need for technology education and technological studies.

Through its current discourse on technological literacy-illiteracy, the field has identified many required key components upon which to build the continuum and framework and meet the challenges identified by Streichler (2000). Basic standards are in place and a framework for achieving them is under development through the Technology for All Americans Project (1996). Higher level standards of technological literacy for trades people, technicians, technologists, engineers, and scientists are available through such sources as the National Skill Standards Board (NSSB) and the Accreditation Board for Engineering and Technology (ABET). Higher levels of technological literacy standards for teachers of technology, as set down by the Council on Technology Teacher Education and the National Association of Industrial and Technical Teacher Educators, are also available. There is recognition of the practical implications for the study of technology (Savage & Sterry, 1990) which include: balancing the "doing" and the cognitive dimensions; integrating knowledge with laboratory activities; including technologi-

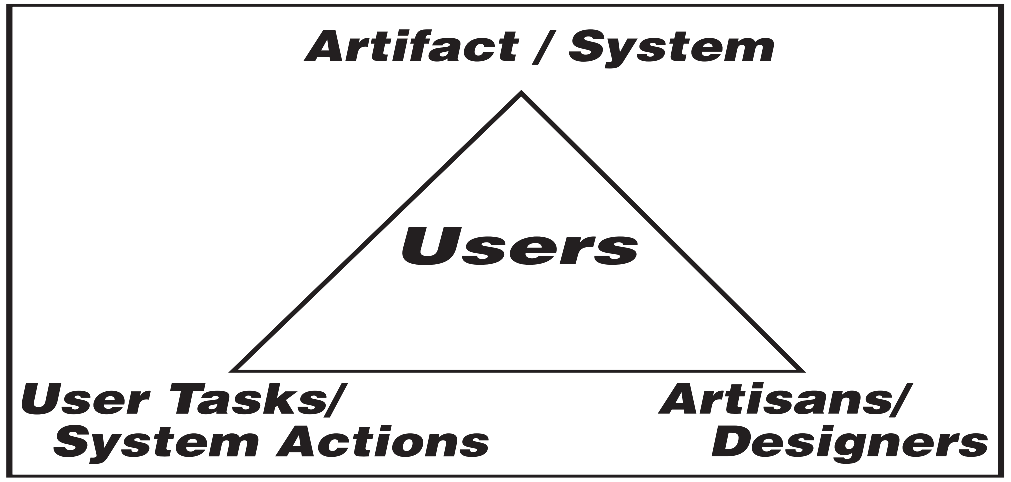



**Figure 1. User-centered triangle.**

cal objects, artifacts, and systems within environmental contexts; distinguishing between technology and science; and defining the role of the human will within the technological problem-solving process. Placing the learner at the center of the process of technology education, and teaching and learning in general, is evidenced by the contributions in Martin (2000) as well as in the research and publications on the brain and learning, intelligence, designing learning experiences, and teaching that are available through the Association for Supervision and Curriculum Development (ASCD) and other professional organizations.

The elements serve as a basis for building a continuum. They address the range of diversity in opinions and beliefs held within the field about what constitutes literacy and capability. And, they comprise a set of essential working functions for a comprehensive, flexible continuum. These functions include:

- Adhering to a standards-based approach.
- Meeting the challenges of: changes in professional behavior; bringing segments of the field together; giving up past concepts and processes; and the quality, direction, and quantity of research in the field.
- Addressing the entire complexity of understanding and using technology in the complete spectrum of its application.
- Teaching and learning for literacy and capability that meet the required range of levels from that of a citizen in general to those of technologist, engineer, or scientist.
- Centering on learning and using technology in a "doing" setting.
- Placing the learner at the center of focus and application.
- Meeting the demands of preparing people for the complex roles required in the development and use of technology.

These workings comprise the framework to link segments together. Without the link the discussion and debate will continue to contribute to highlighting differences instead of emphasizing commonly held fundamentals.

### Standards for Technological Literacy: A Starting Point and Foundation

*The Standards for Technological Literacy: Content for the Study of Technology* (International Technology Education Association [ITEA], 2000) states what all people should know and be able to do with respect to being technologically literate in our global society. This should be the accepted starting point for all approaches to increasing literacy and capability. The standards identify the five key areas of technology—(a) the nature of technology, (b) technology and society, (c) design, (d) abilities for a technological world, and (e) the designed world—and set benchmarks within these areas as performance indicators.

Specifically, the standards state what a student should know and be able to do. The standards also provide for knowing and doing or process by describing the basic knowledge required for literacy and the abilities needed to act technologically. The associated benchmarks offer criteria to assess progress toward both cognition and process. The first three key areas—dealing with the nature of technology, society, and design—involve knowing. The remaining two key areas—abilities and the designed world—primarily address doing within contexts.

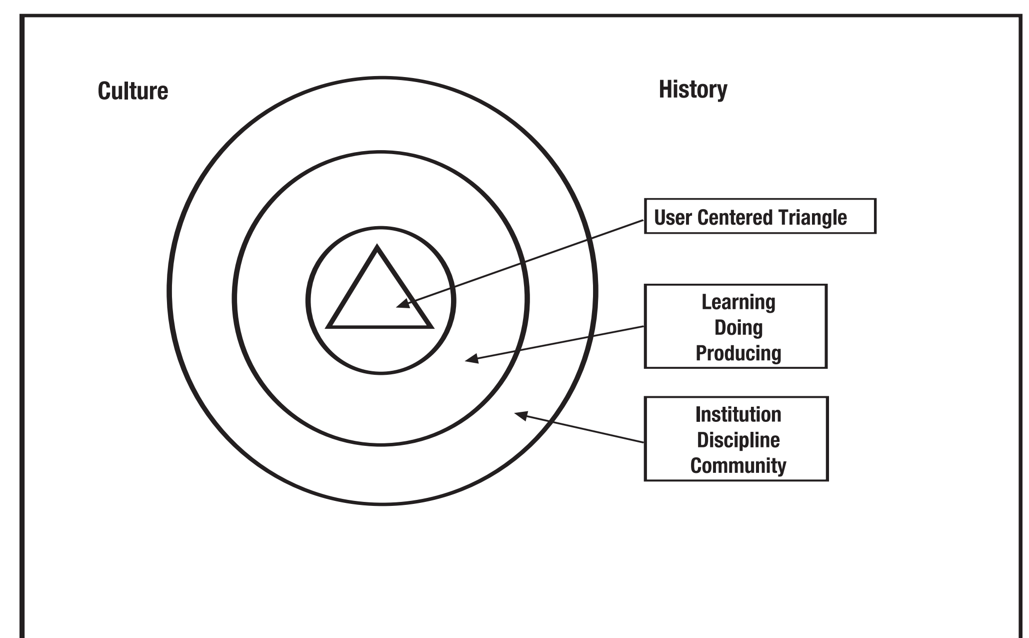
This article operates on the assumption that the *Standards for Technological Literacy: Content for the Study of Technology* (ITEA, 2000) sets a foundation and provides a platform to build increased levels of literacy and capability. And, it is recognized that standards for more advanced forms of technological literacy, such as those under the auspices of the NSSB and accreditation bodies for programs offering associate, baccalaureate, and/or advanced degrees in teaching technology, technical, engineering, and related fields, exist and constitute a more complex set of requirements for specific, in-depth forms of technological literacy that are built upon the basic standards. Without this agreed-upon starting point, the segmented, intrafield focuses on what constitutes literacy-illiteracy will have us running multiple races to reach disparate finish lines.

### A User/Learner-Centered Approach to Meet the Challenges for a Continuum

Where can a flexible, operable model that brings all the elements together be drawn from to provide the framework and continuum? Streichler (2000) suggested that the field turn to the formulations offered within the literature to achieve the "continuum" goal. In taking up this course of action, and to include the professed values of technology education, the field may have to step "out of the box" to reach a consensus. The rationale behind this approach is based on giving equal consideration to all the viewpoints and avoids the appearance of giving precedence to any one segment.

Many other fields of study and practice face similar challenges in dealing with the complexities of technology. Turning to the points of view of these other fields permits a perspective or "out of the box" view of technology education's situation. One such view comes from the field of communications. Here the communicator, usually a writer, is faced with the job of interpreting the use and application of a tool, artifact, and/or system for the purposes of enabling the user to accomplish a technological task or function. The writer relies on the discipline of rhetoric. This is not the rhetoric commonly associated with the use of language as a means to deceive that comes to us from Socrates' descriptions in the *Gorgias* or *Phaedrus*. Nor is it the use of exaggeration or display in language often associated with political campaigns. It is a collection of techniques that makes the production and dissemination of language a strategy by which the writer achieves the purpose of turning the reader into a func-

**Figure 2. User-centered complex of technology.**



tional user of the tool, artifact, and/or system. This latter definition as strategy is a process as much as the process of house building. The end of house building is not the house itself or the builder's use of the completed structure, but rather the use made of the house by those for whom it was constructed.

Johnson (1998) took the above notion of rhetoric as a strategy and applied it to achieving a user-centered approach to technology where humans who interact with various technologies (systems, simple hand tools, appliances, complex electronic networks, etc.) are the primary focus. He pointed out that technology has too often been focused on either (a) the interest of the developers who hope to gain from it, (b) the interest of the disseminators who hope to reap the fruits of its success, or (c) those who develop and release a technology into the public sphere with little or no concern for its intended or unintended consequences.

Johnson (1998) argued that it is the demands of the technological artifacts and systems that drive design and innovation. Human factors are too often left out of consideration in the design and use of technology. His basic premise was that because humans use and apply technology it is necessary to place them at the center of all interactions that involve technology. To remedy the oversight of human factors, he offered the "user-centered complex of technology." This view offers the field of technology education an operable model capable of meeting the requirements of a continuum that prepares people for understanding and using technology in the complete spectrum of its application.

The user-centered complex describes the relationships between users of technology and the designed/created world. The complex is made up of the following elements: (a) artisans and designers, (b) artifacts and systems, (c) user tasks and system actions, and (d) the user. The first three elements are dimensional in form. They can be seen as scaling from one end to the other (i.e., artisans/designers; artifact/system; user tasks/systems actions). These elements are configured in a triangular structure with the first three dimensional elements at the vertices while the fourth element, the user, and for the ends of technology education the learner as well, is placed at the center of all interactions (see Figure 1). For the purposes of this article, user and learner can be considered to be synonymous and interchangeable. All future references to the user will be referred to as user/learner.

The employment of a triangle as a taxonomic device ensures that any one element is always in a direct link with any of the other elements. These links are considered to be dynamic. The sides of the triangle indicate the process of exchange that occurs among the elements. Finally, this triangular, dynamic user-centered complex is set within the shells of learning, doing, and producing; community, discipline, and institution; and culture and history (see Figure 2).

The dimensional elements (artisans/designers, artifact/system, user tasks/system actions) are characterized in the following manner.

*Artisans/designers* are viewed as "creators" of technology. *Artisan* represents the maker of tools, artifacts, and some forms of technologies while *designer* defines the engineer and in some cases the scientist (in the sense of scientist as a participant in the construction of technologies). Teachers of technology, technicians, and technologists can be considered to stand somewhere in between the two ends of this dimension. It is important to note that all the roles in this artisan/designer element often switch places and that the artisan takes on the functions of the engineer and vice versa.

*Artifact/system* defines the "constructs" of technology. *Artifacts* are simple technologies—tools, products, prototypes—created and used independently of other tools, products, and prototypes (at least in any direct physical way). *Systems*, or complex technologies, are usually artifacts physically connected either mechanically, electronically, or in some other direct, interactional manner. Systems can also be viewed as "nonartifactual" technologies such as organizations or networks.

User tasks/system actions are the "contextual subject matter" of technology. User tasks represent technology's actions as perceived by the user/learner. System actions are technology's actions as perceived by the artisan/designer.

The key completing element in the complex is the *user/learner* of technology, who is placed at the center of the other elements, at the heart of the dynamic, collaborative interactions of the other elements.

No technology is developed, disseminated, or used in a vacuum. The user-centered complex operates within the shells of learning, doing, and producing; community, discipline, and institution; and culture and history as depicted in Figure 2. These shells provide the situations and constraints that form the user/learner as well as the artifact/system, user tasks/system actions, and artisans/designers.

Learning and doing, as part the first shell or layer, is where the user/learner is engaged in the design, dissemination, or end use of technological systems or artifacts. Producing, the third component of this shell, engages the user/learner in applying knowledge and skills as a practitioner and producer. This is not just a tool-use model describing user knowledge and ability from a tool-centered, artifact-centered, or systems-centered perspective, because the knowledge and skills of technology are assumed to be in the technology, not in the user/learner. If one accedes to the definition of learning, doing, and producing of a tool-centered model, then one accepts that the knowledge and ability of technology is put there by designers or inventors, not by users/learners. Placing the user/learner in the role of producer entails accepting the user/learner as capable of being an artisan/designer of technology. This also recognizes that users/learners bring the human factor into technological decision making.

The next outward shell constitutes the human networks that constrain technology. These networks—*disciplines, institutions,* and *communities*—probably do not make up a complete list, but do cover much of the territory at this level. These networks easily overlap and create complexes within and among themselves. One example is our own field of technology education or technological studies. Within this discipline there are overlapping communities that are working to achieve numerous missions—general technological literacy for all people, entry-level and continuing career preparation, pre and in-service professional development of teachers, etc.

The outermost shell comprises the factors of *culture* and *history*. These two factors are often invisible but they should not be ignored. Cultural forces define nearly every human action, and in a world more dependent than ever on international communication and technology transfer, the factor of culture becomes essential when defining the use of technology. History, integrally related to culture, refers to the reflective aspect of understanding human action, particularly in terms of responsible, ethical behavior. History informs the understanding of technology in unique and fundamental ways.

Johnson (1998) offered that this "complex" serves the purposes of analyzing technological artifacts and processes; exploring the people who use, make, and/or even destroy technology; helping to examine those who are enamored and/or bored with technology; and studying the user/learner actions within the complex.

## Application of the User/Learner-Centered Approach to the Challenges

How does this user/learner-centered approach apply to the mission of developing technological literacy and capability? The application is based on Johnson's (1998) purposes, primarily studying the user/learner's actions within the complex, but also including the examination of artifacts, systems, design, and human behavior and conditions surrounding using, making, and even destroying technology. In this sense the entire complex serves as a framework or structure for the continuum called for by Streichler (2000). It addresses the challenges by (a) providing for all forms of behavior—including that of users, learners, and professionals—within the field, (b) providing settings where all segments of the field can function in association and collaboration, (c) considering past (historical and cultural) concepts and processes, and (d) providing a research frame of reference with which to gauge a point of interest, debate, concept, and/or process with any other point within the continuum. Most of all it provides a place where the essential working functions described earlier in this article can be included and addressed.

Let us take these four challenges and apply the user-centered complex to them one by one.

### *Behavior*

At any one time a person can take on a multiplicity of roles within technology and technology education. The complex provides for these roles and permits moving freely between and within them. These roles take place in one or more of the shells or layers of the user-centered complex. As a user/learner, designer,

and/or artisan one is primarily involved with learning about and using, doing, and producing with technology. As a teacher and educator one is engaged in conveying the needs, wants, desires, and values of the community, discipline, and institution as they relate to technology's use, production, and application. As a researcher one is exploring, documenting, and formulating the relationships that exist between and among all aspects of the complex from the cultural and historical right down to the more detailed aspects of learning, using, doing, and producing.

Moving from the center of the complex to its outer shell requires one to engage in a number of behaviors. First, acceptance of the concept that technology and technology education exist in an inclusive, universal system imbedded in and encompassed by all of the shells of the complex. Second, through reflection and study, identifying where one stands within the complex with respect to personally held beliefs about each and every element—systems, artifacts, learning, doing, producing, tasks, actions, etc. Third, employing behaviors that embrace a greater and greater amount of willingness to respectfully consider other beliefs and viewpoints, relate one's view to those held by others, and to collaborate in, and establishing where mutual benefits can be achieved for the common good of technology education. And, fourth, promoting and advocating for one's personally held beliefs by placing them within the shells and relating them to all elements of the complex through sound research constructs, methodologies, and documentation.

Various perspectives on what constitutes the types of appropriate professional behavior presented above are found in Gilberti and Rouch (1999). A majority of the contributions to this work, all of which advance various aspects of a framework of professional behavior, are devoted to defining professionalism, identifying opportunities for improvement, and describing model professionalism at various educational levels. It is in the final chapter of Gilberti and Rouch's book that Devier (1999) provides a vision of a desirable professional culture. A vision that recognizes the necessity of individuals possessing a general systematic knowledge of the profession of technology education. This systemic knowledge of the profession furnishes a basis for aligning with the systemic nature of the user-centered complex. This culture of technology education professionalism can be found embedded in the general culture as well as in the networks of the disciplines, segments, and focuses of the field that surround the actions and elements grouped in the center of the complex.

The challenge of changed behavior should be considered as a primary and foundational action for use of the user-centered complex. Meeting the other challenges relies on the appropriate behavior.

***Setting***

The complex, through its elements, provides locations where individuals as teachers and teacher educators can "hang their hats." Teachers can choose to emphasize and promote designing and producing artifacts and/or systems or place stress on user/learner tasks as opposed to system actions within the contexts of the curriculum and programs for which they are responsible. Using the elements to provide a holistic view of the complex of technology, teacher educators can then proceed to stress those things that are necessary to prepare students to meet the standards of certification for specific areas—K-12 general education, high school career and technical preparation, postsecondary technologist training, or higher education at the baccalaureate and graduate levels. The basic requirement is that they, and this goes back to behavior, recognize and accept that the emphasis, promotion, and stress take place within the complex. Rejection will, at the least, create a self-imposed isolation within the complex and at its extremes result in a disruption of the continuum leading to segmentation and disunity.

***Past Concepts and Processes***

The field cannot escape the fact that current and future concepts and processes rest on that which has happened in the past. The historical and cultural elements provide a location to address the issues that revolve around the inclusion of past concepts and processes without ignoring or eliminating them. Set within the complex, the concepts and processes of technology can be considered to the degree necessary to achieve the desired educational outcome. At a minimum it may only be necessary to cite the lineage of a contemporary concept/practice to reach a standard or benchmark. In other instances including the past concept/process may be needed to build required contemporary knowledge and ability. And finally, emphasis and in-depth use of a key past concept/process may be the only avenue to achieve a very high degree of knowledge and ability that is essential in a particular technological application. The complex's historical and cultural elements coupled with the elements of institution, discipline, and community provide two mechanisms to deal with the past—"handles" to grasp the placement and significance of the past in relationship to the present practices and "platforms" to launch forecasts and speculation on where any concept/process may lead to.

***A Research Frame***

The entire complex provides a context that permits a hypothesis to be framed in a manner that can display its linkages to all elements of the technological setting. History and culture; discipline, community, and institution; learning, doing, and producing; artifact/system, user task/system action, and artisan/designer; and, most of all, the learner/user constitute places on the continuum where questions can be focused. Granted that the nature of research requires one to consciously and deliberately structure and focus the process of questioning to achieve specific answers within a range of probability. However, the process of questioning does not obviate the milieu in which the research takes place. Basically, the complex provides parameters that prompt consideration of a question within the milieu.

## Meeting the Remaining Essential Working Functions for a Continuum

The user-centered complex, because of its inclusive nature, can accommodate the other remaining functions for the establishment of a continuum. Let us examine each in relation to its place in the complex.

***Understanding and Using Technology in a Spectrum of Application***

Addressing the entire complexity of understanding and using technology in the complete spectrum of its applications can take place by focusing on the elements of the model. The elements provide specific places and contexts for the application of technological understanding and ability. The elements of the shells and the triangle can be associated with activities ranging from the general to the specific, from basic cognition to in-depth understanding, and from a use of modest technical abilities to that of very highly refined levels of ability. The user tasks, system actions, designing and/or producing, as well as working within the networks of discipline, community, and institution, all come into play.

***Teaching and Learning for a Range of Literacy Levels***

The networked elements within the complex of community, institution, and discipline provide settings for accomplishing teaching and learning for literacy and capability that meet the required range of levels from that of a citizen in general to those of teacher of technology, technologist, engineer, or scientist. A citizen, in general, may never be required to go beyond the need to know about those things technological that are necessary to preserve our democratic society, while this same citizen, as a productive worker, will be required to know about and be able to do things with particular technologies in order to continue in and perhaps advance him or herself in his or her job or career. Taking this scenario a step farther one can go to those jobs, careers, and professions that are specifically technological in nature. Here in-depth knowledge and abilities ranging from designing and producing a particular artifact right on through to systems design and application are required. All can be taught in appropriate settings and at a designated time provided by the situations and constraints of the complex.

***A Setting of "Doing"***

Centering on learning and using technology in a "doing" setting is evident in that the complex explicitly includes this essential activity. Learning and producing cannot be achieved in a passive manner. If one were to remove doing from the complex, it would destroy the learning and producing elements of the structure.

***Learner Centered***

The heart of the complex is the learner at the center of focus and application. Everything depends on the presence of the learner/user. Johnson's (1998) theoretical constructs are based on this most primary concept. The reality of leaving the learner out not only destroys the complex, but it destroys the whole notion of providing any form of education whatsoever.

***Preparation for Complex Technological Roles***

The rationale for "teaching and learning for a range of literacy levels" also applies to meeting the demands of preparing people for the complex roles required in the development and use of technology. The situations and constraints of the model provide the appropriate settings for achieving the complexities associated

with the various roles a person plays in a technological world. The complex answers the demands placed on it by accommodating to meet the level of literacy required to perform a technological role, be it elementary or in-depth.

### Who Is Responsible in Achieving Technological Literacy and Capability?

The user-centered complex of technology offers one way of dealing with the questions: To what extent or degree should literacy and capability be achieved at any given time and place? and Where should it be achieved? The answer to these two questions provides an indication of the framework's parameters to be dealt with in a holistic continuum. It does not directly address "who" is responsible.

The "who" responsible is every individual in the field of technology education and technological studies. This means that, by engaging in proactive professional behavior, we all begin to recognize, endorse, and promote the systemic, holistic nature of technology and the development of technological literacy and capability within a framework such as the user-centered complex of technology.

The problem may be that we have been looking at any one individual segment of the field as if this perspective is the only view and then promoting this perspective as a definitive model. In the field of physics this concept is termed a *duality*. A duality exists when models appear to be different but nevertheless can be shown to describe the same thing (Greene, 1999).

Dualities are of two types. The first is when ostensibly different models are actually identical and appear to be different only because of the way they happen to be presented. An example of this would be if someone only fluent in English were to describe the process of turning but would be unable to recognize the description if it were presented in Chinese. A person fluent in both languages could easily perform a translation and establish their equivalence. Then second is when distinct descriptions of the same thing do present different and complementary insights. In this instance, where dual (or multiple) descriptions are provided for a single universe, in our case technological literacy and capability, important insights that follow from using dual descriptions can be achieved. Both types of dualities are resolved through an acceptance of a universal, systemic domain in which translations can be made and dual insights be accepted.

Solving this problem of looking at individual segments of the field as if each perspective is the only definitive model could be addressed through the application of the user-centered complex of technology. The complex provides a way of addressing the field's diverse segments and missions while maintaining a universal, systemic framework for developing technological literacy and capability. In addition, the complex meets Streichler's (2000) call for a continuum in that it describes a framework in which a fundamental common character—technological literacy and capability—is discernable amid a series of variations.

### Next Steps

Where does technology education go next in the use of this user-centered complex of technology or any other model similar in nature? If this approach is accepted, then technology education must continue to (a) define, develop, practice, model, and teach the proactive professional behaviors that hold the continuum in place and (b) extend knowledge and practices that clearly define, characterize, and promote all the elements within the complex. The field has numerous forums for achieving both of these initiatives. They include the Mississippi Valley Technology Teacher Education Conference, the International Technology Education Association and its councils, the *Journal of Technology Studies*, and the *Journal of Technology Education*. Through these forums the ideas and concepts can be refined, directed, and applied in a meaningful manner.

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